THE IDENTITY OF APIS AESTUANS LINNÉ, 1758, AND RELATED OLD WORLD CARPENTER-BEES (XYLOCOPA LATR.)

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Abstract. — The primary object of this paper is to establish the identity, synonymy and habitat of some Old World carpenter-bees (*Xylocopa* Latr.) described by the earliest writers. Apart from two previously discussed Fabrician species, the present list includes the Oriental *Apis aestuans* L. and the African *Xylocopa pubescens* Spin. Redescriptions and illustrations of these are given and VITZTHUM's designation of *Apis aestuans* L. as the type of subgenus *Koptortosoma* Gribodo is accepted.

In an article soon to follow in this volume Mr. G. L. VAN EYNDHOVEN will summarize the results of an investigation of some *Dinogamasus* mites extracted from the pouches of *Koptortosoma* bees dealt with in the present paper.

An investigation of the characters of a number of *Koptortosoma* has resulted in the following nomenclatorial changes, new synonymies and distributional data:

Apis aestuans L., 1758 = *X. (Koptortosoma) aestuans* (L.), Oriental. Stat. nov.
= *Apis leucothorax* De Geer, 1773. Syn. nov.
= *Xylocopa confusa* J. Pérez, 1901 et auct. Syn. nov.

Xylocopa pubescens Spinola, 1838 = *X. (Koptortosoma) pubescens* (Spin.), Africa, India. Stat. nov.
= *Xylocopa aestuans* auct. nec Linné.
= *Xylocopa leucothorax* auct. nec De Geer.

X. (Koptortosoma) bryorum (Fabr., 1775), Oriental.
= *Xylocopa separata* J. Pérez, 1901. Syn. nov.

X. (Koptortosoma) ruficornis Fabr., 1804, Oriental.
= *Xylocopa verticalis* Lepeletier, 1841. Syn. nov.

X. (Koptortosoma) minor Maidl, 1912, Oriental. Possible synonymy discussed.

X. (Koptortosoma) perversa Wiedemann, 1824, Oriental. Description of *X. (K.) p. plagioxantha* subsp. nov. (Malay Peninsula) with key to both sexes of four subspecies and notes on the ethology of one.

X. (Koptortosoma) lundquisti Lieft., 1957, Papuan. Sexes associated and description of hitherto unknown male from South New Guinea.

X. (Subgenus?) ocularis J. Pérez, 1901, Oriental. Notes on variation and distribution.

In a recent paper published by P. D. HURD, Jr. (1959), entitled "Some nomenclatorial problems in the genus *Xylocopa* Latreille", the author has made it clear that the status of *Koptortosoma* Gribodo, 1894, cannot be satisfactorily

understood before the question of its type species is solved. It constitutes a group of carpenter-bees distributed all over the Old World tropics and comprises a great number of species. Before this category had become better known, it was characterized in a more restricted sense by T. C. MAA as *Orbitella* Maa, 1938. This being a preoccupied name, it was substituted first by *Maiella* Michener, 1942, and shortly afterwards by *Euryapis* Sandhouse, 1943, all of these units having *Xylocopa confusa* J. Pérez as genotype. Up to the present time the subgenus was best known as *Maiella* Michener, many Oriental and Papuan species having been treated under that name more recently by LIEFTINCK (loc. cit. infra, 1955, 1956, 1957a and 1957b).

The intricate nomenclatorial history of *Koptortosoma* has been adequately summarized by HURD in the above-mentioned publication. At that time the subgeneric position of *Apis aestuans* Linné was not yet definitely known, because LINNÉ's type specimen, a female without proper locality, did not appear to have been studied by any competent writer. In order not to further complicate an already confounded situation, HURD suggested to accept the selection made by SANDHOUSE and to designate the African *K. gabonica* Gribodo as the genotype, rather than following VITZTHUM's earlier (1930, p. 315) contention that *Apis aestuans* L. should be the type species of *Koptortosoma.* As will be seen below, *aestuans* is a true *Koptortosoma*; and since it was one of the several species included by GRIBODO in his original proposal, this selection would seem to be the correct one. However, HURD's reasons for taking *gabonica* instead were, firstly, that the provenance of the type of *Apis aestuans* is unknown, and secondly, that the true status of this female has never been critically established by comparison with other species of that sex.

The only really important task was, therefore, to search for LINNÉ's bee and to establish its identity. It has been the purpose of the present investigation to effectuate this.

The most obvious premise was, of course, not to accept the old interpretation of *X. aestuans* as postulated by TASCHENBERG, FRIESE and others, but to follow the example set by MAIDL (1912) and MAA (1938), who selected *Apis leucothorax* De Geer, 1773 (supposedly from Egypt), as the most acceptable substitute for *aestuans*, leaving the status of the latter undecided. MAIDL was certainly justified to do so because DE GEER himself had considered these bees identical species. The obvious way to follow was, therefore, to attempt a confrontation of LINNÉ's female of *aestuans* with DE GEER's type of *leucothorax.*

The following is an attempt to clear up the nomenclatorial problems associated with some similarly-looking species of *Koptortosoma* described in the past.

Xylocopa (Koptortosoma) aestuans (Linné, 1758) (pl. 16 figs. 1—6)

Selected references:

1758. LINNÉ, Syst. nat., Ed. 10a, 1 : 579, n. 37. — ♀ "Habitat *in* calidis *regionibus*". (*Apis aestuans* nob.)

1773. DE GEER, Mém. hist. Ins. 3 : 573, pl. 28 fig. 7 (insect). — ♀ "Egypte", sec. REAUMUR (*Apis leucothorax* nob.) Syn. nov.

1901. Pérez, Actes Soc. Linn. Bordeaux, 56 : 57—60 (♀ ♂ excl. var.). — ♂ lectotype, Java, Mus. Paris (*Xylocopa confusa* n.sp.). Syn. nov.
1930. Vitzthum, Zool. Jahrb. Abt. Syst., 59 (2/3): 314—315 (designation of *Apis aestuans* L. as type of *Koptortosoma* Grib.)
1938. Maa, Rec. Ind. Mus., 40 : 306 (key ♂ ♀), 313—314. — ♂ ♀ Java etc. (ex parte?) [*X. (Orbitella) confusa* J. Pér.]
1955. Lieftinck, Verh. Naturf. Ges. Basel, 66 : 8, 13—14, 17 (key ♂), fig. 2 (armature femur ♂). — ♂ W. Java [*X. (Maiella) confusa* J. Pér.].
1957. Lieftinck, Proc. Kon. Ned. Akad. Wet., ser. C, 60, no. 3 : 441—450 (incl. full references), figs. 10—26 (struct.). Type ♂ *Apis bryorum* F. redefined; descr. & figs., with localities, for both species [*X. (Maiella) confusa* J. Pér.].

Already in November, 1962, Dr. E. Kjellander, of the Naturhistoriska Riksmuseum at Stockholm, had confirmed the type of *Apis aestuans* to be extant and still lodged in Linné's collection at Uppsala. The specimen was not seen by me, but a number of female "*aestuans* auct." (i.e. the alleged *leucothorax* De Geer), provided with full particulars about specific characters deserving special attention, were sent to Stockholm for perusal and comparison with the type. The assortment consisted of specimens from the eastern Mediterranean, some of the examples (from Egypt and Israel) bearing identification labels "X. *aestuans*" in H. Friese's writing; these are, in fact, duplicates of the series used by that author in vol. VI of his "Bienen Europa's" (1901). Others are from Syria, and all are identical with Maidl's specimens of "*leucothorax*" from Egypt and Syria of which I had seen both sexes in the Vienna Museum.

In a letter dated Dec. 7, 1962, Dr. Kjellander kindly complied with my request by writing as follows:

"... I had the opportunity to examine the Linnean type, which is in very good condition. The type is placed in box Nr. 24. There are two labels before the species, viz. "aestuans Mus. Gust. Ad.", written by Thunberg, and "Xylocopa aestuans", written by Aurivillius."

He then proceeds to give a number of characters by which Linné's type of *aestuans* differs from the specimens submitted for comparison. These points of distinction, in conjunction with other important features discovered subsequently, are incorporated in the table given below.

Considering the above information, and after consultation of the photographs of the type supplied by Dr. Kjellander (pl. 16 figs. 1—4), I found that *Apis aestuans* L. could not possibly be conspecific with the *X. leucothorax* of recent authors. In view of this, it became a *conditio sine qua non* also to examine De Geer's type of that species (pl. 16 figs. 5—6). This is preserved in the Stockholm Museum and Dr. Kjellander has been kind enough to let me study it. The unique female unfortunately lacks its head, but I soon became convinced that *leucothorax* and *aestuans* are conspecific. The venation and colour of the wings are quite alike, and no differences could be discovered in the extent and density of the yellow and black vestiture of the body. Consequently, I do not hesitate to proclaim that *leucothorax* is synonymous with *aestuans*.

About the provenance of these two old individuals we are still in the dark; it is unlikely that a decisive answer to this question can ever be given. De Geer, after his diagnosis of *leucothorax* ("Abeille velue noir, à corcelet jaune citron,

à ailes d'un noir violet & à ventre lisse"), further remarks on his specimen: "Je ne connois [sic] point au juste le pays natal de cette Abeille, mais M. de Reaumur dit, qu'elle se trouve en Egypte; elle est presque aussi grande que les plus gros Bourdons de l'Europe". Etc.

It follows, that even of the unique type specimen of *leucothorax* the original locality is not known with any degree of certainty. It should be borne in mind that the female of *aestuans* (= *leucothorax*) is superficially closely similar to *pubescens,* and that Egypt is the terra typica of the latter. Further details will follow and are given under that species.

Hence all we can say about the habitat of the types of *aestuans* and *leucothorax* is that both must have reached Europe from some country in the East Indies.

There are several Asiatic and Australian species of *Koptortosoma* whose females exhibit a contrasting colour design similar to that of *aestuans* (e.g., *aruana* Rits., *bryorum* F., *confusa* J. P., *flavonigrescens* F.Sm., *hafizii* Maa, *mckeani* Ckll., *ruficornis* F.), but only two of these are likely to be confounded with it, viz., *bryorum* and *confusa.* Both are Oriental in their distribution and in some places (e.g., the Malay Peninsula) even occur together. X. *bryorum* has, however, a more westward range than *confusa* (see p. 141). These facts are, of course, no help in answering the question which of the two is the true *aestuans.* However, when taking into account the characters these bees share alike in conjunction with the few points by which they differ; and considering also the scarcity of *bryorum* in comparison with the widely distributed and very common *confusa,* there can be hardly any doubt that *confusa* also is synonymous with *aestuans.*

Leaving aside *bryorum,* for which I am still unable to detect female characters sufficiently constant to separate it from *aestuans,* the females of the two species can be separated thus:

aestuans (= *confusa* auct.)

Head distinctly broader than long,[1]) length: breadth ratio = 1 : 1.45, but more triangular in outline, the occipital area lower, upper margin almost straight in frontal view. Interocellar distance markedly less than ocellocular distance (64 : 100). Clypeus densely punctate, but with distinct, slightly raised, longitudinal impunctate line down the middle. Flagellar segments of antennae long, 3rd segment slender, fully 3 times as long as its width at apex and distinctly longer (100 : 73.5) than 4 + 5.

pubescens

Head scarcely broader than long, length: breadth ratio = 1 : 1.20, subcircular in outline, the occipital area higher and more strongly convex in frontal view. Interocellar distance almost ¾ of ocellocular distance (74 : 100). Clypeus evenly densely punctate without indication of a median impunctate line. Flagellar segments of antennae shorter, 3rd segment more nearly parallel-sided, from 2.3—2.5 times as long as its width at apex and only slightly longer (100 : 84) than 4 + 5.

[1]) Length measured along median line, from top of head to anterior margin of clypeus.

Distal side of third submarginal cell of fore wing (third intercubitus, R_4 or im^2) convex, the bend removed analwards, well beyond half-way its course. Black pubescence of gastral tergites somewhat longer and denser. Yellow pubescence of thoracic dorsum darker, more orange-yellow. Polished impunctate median area of mesoscutum very narrow, the tips of the medially inclined decumbent yellow hairs on either side of it almost meeting. Median mesoscutal line more deeply and strongly impressed, especially towards the end.

Distal side of third submarginal cell of fore wing evenly convex, the bend situated exactly mid-way its course. Black pubescence of gastral tergites short and sparse. Yellow pubescence of thoracic dorsum lighter, citron-yellow to canary-yellow. Polished impunctate median area of mesoscutum wider, suboval, the tips of the medially inclined decumbent yellow hairs on either side of it not nearly meeting. Median mesoscutal line feebly, less sharply, impressed.

Material. — The type specimen of *Apis leucothorax* De Geer bears an illegible pin-label in Swedish, not in De Geer's handwriting; a second label written by Prof. J. Sundevall prior to 1844 reads: "A. à corcelet jaune/Apis leucothorax T. 3 p. 573", and two recent museum labels "363" (pink) and "Riksmuseum Stockholm" (green). The type male of *X. confusa* J. Pérez is from "Java". Most, if not all, of Maa's (1938) records from within Indian limits (sub *leucothorax* De Geer) apply to *pubescens* Spin. Besides the specimens examined on earlier occasions (Lieftinck, supra, 1955 and 1957, sub *confusa* J.P.), I have been able to study many others including also some females from northwestern countries (Thailand, Burma). However, these latter occurrences rest upon few, perhaps unreliable, records, so that further data are desirable.

Remarks. — *X.* (*K.*) *aestuans* is essentially a species of tropical Asia with its headquarters in the Malaysian subregion. It has not been found in Africa. As will be seen from an examination of the *Dinogamasus* mites with which *aestuans* and its immediate allies are found associated, the former show marked differences in comparison with those occurring in the pouches of the African *pubescens*, different species-groups of mites having been recognized in correlation with the groups of bees that bear them.

As far as at present known *aestuans* ranges from Indochina through the archipelago as far as Celebes and Flores in the Lesser Sunda chain.

Xylocopa (Koptortosoma) pubescens (Spinola, 1838) (Plate 17 figs. 7—8, textfigs. 1—5)

Selected references:

1742. Reaumur, Mém. hist. Insect., 6 : 3 and 34, pl. 3 figs. 2 & 3 (♂ & ♀). — ♂ ♀ "Bourdon d'Egypte" (*sine nomine*).
?1812. Savigny, Descr. Egypte, Hym., T. 3 fig. 4 (insects). — ♂ ♀ Egypt (*sine nomine*).
1838. Spinola, Ann. Soc. Ent. France, 7 : 518—519, nr. LXIV, Var. D. — ♂ Egypte (*Xylocopa pubescens* Klug mss.)
1841. Erichson, Archiv f. Naturgesch. 7 (2): 215—216, notes (*Xylocopa pubescens* Spin.)
1841. Lepeletier, Hist. Nat. Ins. Hym. 2 : 193 (pars), T. 17 fig. 3 (♀), not fig. 4 (♂). — ♀ ♂ "Egypte. Pondichéry": probably only the ♀ from Egypt (*Xylocopa aestuans* Latr. & L.)

1879. TASCHENBERG, Zeitschr. Ges. Naturwiss. 52 (3. Folge, Bd. 4): 593—594 (composite descr.: ♀ ♂ Java, ♀ Egypt). — ♀ Egypten (*Xylocopa aestuans* L. = *leucothorax* DeG.).

1881. GRIBODO, Ann. Mus. Civ. St. Nat. Genova, 16 : 230—231 (partim: Egitto, Nilo Bianco, Scioa (*Xylocopa aestuans* L.).

1884. GRIBODO, Ann. Mus. Civ. St. Nat. Genova, 20 : 381. — ♀ Yemen, no descr. (*Xylocopa aestuans* L.)

1884. GRIBODO, Ann. Mus. Civ. St. Nat. Genova, (2) 1 : 278. — ♀ ♂ Scioa, no descr. (*Xylocopa aestuans* L.)

1899. VACHAL, Misc. Entom. 7 : 148 & 154 (28 & 34 sep., key ♀ ♂). — ♀ ♂ "de l'Egypte au Sénégal cc." [*Xylocopa (Koptortosoma) aestuans* L.]

1901. FRIESE, Bienen Europa's, 6 : 198, 200 & 202 (key ♀ & ♂), 225—227 (partim). — ♀ ♂ Aegypten; Jericho; Dalmatien (*Xylocopa aestuans* L. + var. *pubescens* Spin.)

1901. PÉREZ, Actes Soc. Linn. Bordeaux, 56 : 39—40; 57—60 (comp. with *confusa* n.sp.). — ♀ ♂ Egypte; ♀ ♂ Sénégal, pars? (*Xylocopa aestuans* L.)

1909. FRIESE, Bienen Afrikas, Jenaische Denkschr. 14 : 242, composite descr. (*Xylocopa aestuans* L.)

1912. MAIDL, Ann. k. k. naturh. Hofmus. Wien, 26 : 261 and 277—278. — ♀ ♂ Aegypten & Syrien; ♀ ♂ Südarabien & Sokotra, Senegal & Deutsch-Ostafrika, partim? [*Xylocopa (Koptorthosoma) aestuans* L. + *leucothorax* DeG.]

1927. ALFKEN, Ent. Mitteil. 16 : 152, note. — ♀ ♂ Persische Golf: Buschehr & Bender Abbas [*Xylocopa (Mesotrichia) aestuans* L. = *leucothorax* DeG.]

1938. MAA, Rec. Ind. Mus., 40 : 306 (key ♂ ♀), 307—309 (descr., full references and locs.). — ♂ ♀ India throughout, incl. N.W. Frontier Prov. [*Xylocopa (Orbitella) leucothorax* de Geer]

1950. BENOIST, Bull. Inst. français Afr. noire, 12 : 1. — ♀ Dakar, no descr. (*Xylocopa aestuans* L.)

1950. BENOIST, Bull. Soc. Sci. Nat. Maroc, 30 : 42. — ♂ ♀ S. Morocco, loc. diff., no descr. (*Xylocopa aestuans* L.)

1959. GUIGLIA, Atti Soc. Ital. Sci. Nat. Mus. Civ. Genova, 98 (4): 317. — "Fezzan; Eritrea; Dancalia; Somalia; Etiopia; Aden" [*X. (Mesotrichia) aestuans* L.)

This carpenter-bee may arouse even greater historical interest than *aestuans*, because it was DE REAUMUR who had already characterized both sexes of another species, sixteen years before LINNÉ published his diagnosis of *Apis aestuans* in the "Systema naturae", well over two centuries ago. In the 6th volume of his "Mémoires pour servir à l'histoire des insectes" (1742 : 3 and 34), DE REAUMUR gave an interesting account of a "bourdon" from Egypt, — evidently the same bee as the one here treated as *Koptortosoma pubescens* (Spinola). This learned scientist's observation reads as follows: — "Outre les bourdons qui sont presque couverts de longs poils, il y en a qui n'en ont de longs que sur le corcelet, & qui les ont courts sur le corps. M. Granger m'en a envoyé de ceux-ci (Pl. 3 fig. 2) d'Egypte, dont tous les poils sont d'une belle couleur d'olive, & dont les ailes tirent sur le violet. Il m'en a envoyé d'autres (Pl. 3 fig. 3) du même pays, dont le corcelet est couvert par-dessus, de longs poils d'un beau citron, & dont les anneaux de corps sont ras, & même lisses & luisants. Ces anneaux sont d'un noir qui tire sur le violet; un violet moins noir, mais pourtant foncé, est aussi la couleur de leurs ailes." REAUMUR's pictures clearly represent male and female of the same species and he surely had these bees in mind when DE GEER consulted him about the provenance of his *leucothorax* female! As we have seen before, the last-mentioned specimen belongs to a different species inhabiting other parts of the Old World.

Our Egyptian bee is unquestionably one of the varietal components of *Xylocopa pubescens* Spinola (Klug, in litt.), duly recognized by Klug among the material in his own collection as a mixture composed of four kinds of males originating from three or four different regions. Klug had already given

Figs. 1—5. *X. (Koptortosoma) pubescens* Spinola, ♂ from Syria. Fig. 1, basal portion of left posterior leg, seen from behind; fig. 2, trochanter and femur of right posterior leg; figs. 3—5, genitalia and details thereof, dorsal (3—4) and left lateral view (5), different enlargements.

specific names to each of these males, but Spinola marshals them into an equal number of varieties of a single species, selecting *pubescens* Klug (in litt.) as the nominotype.

It is interesting enough to quote in full SPINOLA's characterizations of these male varieties of *pubescens*, which are found on p. 519 of the "Compte Rendu":

"LXIV. XYLOCOPA PUBESCENS, *Klug*. Je lui conserve le nom sous lequel M. Klug me l'a envoyée, et sous lequel elle est sans doute étiquetée dans le Musée de Berlin. Mais c'est la femelle de la *Xyloc. aestuans*, Fab. M.Savigny les a en effet réunies, *Exp. d'Eg., loc. cit.*, pl. 3, fig. 4, ♂ et ♀. Cette espèce est très-répandue dans les contrées chaudes de l'ancien continent. On la trouve en Égypte, au Cap de Bonne-Espérance, aux Indes-Orientales, à Java, etc. Le mâle varie beaucoup par les couleurs de sa fourrure. Lorsque les différences de localité ont coïncidé avec les différences des couleurs, on a cru naturellement à la différence des espèces. Cependant ces *Xylocopes* ne sont pas rares dans les pays qu'elles habitent; on aurait dû trouver les femelles distinctes de ces mâles qu'on prétendait distinguer entre eux. Or c'est ce qui n'est pas arrivé. On a trouvé partout la même femelle, et cette femelle était toujours l'*aestuans*, Fab. Je dois à l'obligeance de M. Klug la connaissance de quelques-unes de ces prétendues espèces qui ne sont à mon avis que des variétés mâles.

Var. A. — *Xylocopa olivacea*, KLUG. — Chaperon testacé. Pélage de la tête et du corselet roux: celui de l'abdomen d'un jaune plus pâle: face extérieure du premier article des tarses couverte de poils jaunes. — Indes-Orientales et Java.

Var. B. — *Xylocopa capensis*, KLUG. — Chaperon noir; bord antérieur et une tache au milieu testacés. Pélage de la tête, du corselet et de l'abdomen, de la même teinte jaune, un peu olivâtre. Tarses comme dans la *Var.* A. — Cap de Bonne-Espérance.

Var. C. — *Xylocopa sulphurea*, KLUG. — Chaperon noir; bord antérieur jaune; point de tache médiane. Pélage du corps comme dans la *Var.* B. Face extérieure du premier article des tarses couverte de poils noirs. — Cap de Bonne-Espérance.

Var. D. — *Xylocopa pubescens*, KLUG. — Chaperon noir, sans taches. Pélage du corps comme dans les *Var.* B. et C. Tarses antérieurs comme dans la *Var.* C. — Égypte."

Unfortunately, not one of the above males could be recovered by Dr. KÖNIGSMANN in the old collections of the Berlin Museum, and a search for them among SPINOLA's material in the Paris Museum and the Museo di Zoologia della Università at Torino proved equally unsuccessful. It must be assumed, therefore, that these type specimens have been lost or destroyed.

Var. A, *X. olivacea* Spinola, is preoccupied by *X. olivacea* (Fabricius, 1787) from Sierra Leone, which according to LEVEQUE is a synonym of *X.* (*Koptortosoma*) *caffra* (L.). (*X. olivacea* F. Smith, 1854, also from Sierra Leone, may or may not be the female of that species).

Var. B, *X. capensis* Spinola, is a validly proposed name for a species of *Koptortosoma* of unknown identity. It antedates *X. capensis* Lepeletier, 1841, lectotype female from the Cape, which is altogether different and belongs to an other subgenus.

Var. C, *X. sulphurea* Spinola, also appears to be a valid name for a distinct species of *Koptortosoma*. As long as the where abouts of the unique type are unknown, *sulphurea* must, however, remain a nomen dubium.

Var. D, *X. pubescens* Spinola, from Egypt, the nominotype of the collective species, is the only member of the group which shows no trace of yeliow markings on the clypeal area. The extensive series of male topotypes on hand agree well with the brief diagnosis given by Spinola. It has therefore been decided to revive the name *pubescens* and apply it to the well-known bee hitherto called *aestuans* or *leucothorax*. Since good series of both sexes collected in Egypt by Ehrenberg are still extant and preserved in the Berlin and Amsterdam Museums (including those ex coll. H. Friese & O. Vogt), I have designated one of the males in the Berlin Museum as lectotype of *pubescens*. The selection of one of Ehrenberg's bees seems most appropriate because C. G. Ehrenberg and J. Ch. F. Klug are the authors of the work "Symbolae Physicae" (Berlin, 1829—1845) and Klug may well have received his bees from Ehrenberg. The old Egyptian specimens in the Paris Museum, though also collected about 1833—4, were obtained from French scientists. In all probability these have been before Spinola when he described the species in 1838; in any event they were not Klug's.

Material. — Syria: 1 ♀, Syrien, Ehrenberg, no. 64, sub *aestuans* var. *leucothorax* (ZMB); 1 ♂ 1 ♀, Jordan valley, 1899, Morice, *X. aestuans* L., det. Friese 1900, ex coll. O. Vogt (MA). Palestine: 1 ♀, Jerusalem, H. Rolle vend. (MA). Egypt: 5 ♂ 4 ♀, Aegypten, Ehrenberg, sub *aestuans* var. *leucothorax* (ZMB), one pair of these (mounted), nos. 63 & 68, with additional dark green labels: "Aegypt. (or Egypt.), Ehrbg. xxvi/10—11" (♂) and "xxvi/140" (♀), in Ehrenberg's writing, and others with "ad Saccaharam", "Eg.Ehr." and "Habysj" (partly illegible); 1 ♀, Aegypten, Gayot (?) coll., with additional label: "703 Mites taken, N. L. 1932" (ZMB); series, both sexes, Aegypten, Pyramiden, II, H. Rolle, one ♀ *X. pubescens* Spin., det.? (MA); long series, both sexes, Egypt, ex coll. O. Vogt (MA); 1 ♂, Aegypten, Suez, terrain cultivé, Ascherson S., 8.6.1886, *X. aestuans* L., det. Dr. Enderlein, ex coll. O. Vogt (MA); 1 ♀, Aegyptus and 1 ♀, Egypte, Ismailia, J. van Bemmelen (ML); 1 ♂ 1 ♀, Egypte, Mus. Ber. (ML); 1 ♀, Roda, Egypt, 18.7.45, Straszynski (MA); 5 ♂, four bearing a disc (green on one side) with the numbers 2052/79, 2062/34, 2064/73 and 2065/99, and with printed pin-labels "Museum Paris, Egypte, Bové 1833" (one with additional "Env. le Caire") and one with similar disc 2862/34 and "Egypte, Banon 1834" (MP); 5 ♂, with similar discs 315/50 and printed pin-labels "Mus. Paris, Egypte, Clot-Bey, 315/50" (MP). Nubia and Sudan: 1 ♀, Bahr el Abiad, Felder (ML); 8 ♂ 2 ♀, Egypt, Nubia, 2—4 km NNE of Abu Simbel temple, 40.XII.1962 (1 ♂), 1.I.1963 (5 ♂ 1 ♀), 8.I.1963 (1 ♂ 1 ♀); 4 ♂ 9 ♀, same area, Abu Simbel village, E-bank of Nile, 3.I.1963 (1 ♂), 6½ km NNE of Abu Simbel temple, 1 km S- of Gindinarri, and Tamit, 6.I.1963 (2 ♂ 6 ♀), 1 km S of Abu Simbel temple, 11.I.1963 (1 ♂ 3 ♀); all L. D. Brongersma (ML); 3 ♀, Sudan, Khartum, I—II and 8.IX.1935, coll. A. Mochi (MA); 2 ♀, Sudan, El Gereina, 30.XII.1961, F. Barnie (ML); 1 ♂, Afrique orient. angl., Rendilé (Mont. Karoli), Maurice de Rothschild, Mai 1905 (MP). NW and W. Africa: 2 ♀, Morocco, Atlas, Glaoni (?), 7.905, ex coll. O. Vogt (MA); 1 ♀, Kamerun, Victoria, Preuss S., *X. aestuans* L., det. Dr. Enderlein, ex coll. O. Vogt (MA). West Asia: 1 ♂ 2 ♀, S. Iran, Djask (Gulf of Oman), August

1934, Miss C. R. BAKKER (ML). India: 1 ♂, Hindustan, WESTWOOD, ex coll. F. SMITH, 8/76, "*X. aestuans*, Indian form", det.? (ML); 1 ♀, Madras, *X. confusa* Pér., ex coll. et det. H. FRIESE 1925 (coll.m.); series ♀, S. India, Pondichery State, Karikal, Feb. 1962, P. S. NATHAN (ML); series ♀, Anaimalai Hills, Cinchona, 3500 ft., Apr. 1962, P. S. NATHAN (ML) — Lectotype ♂ and lectallotype ♀, by present designation, the nos. 63 and 68 from Egypt in the Berlin Museum, bearing additional handwritten labels in EHRENBERG's writing (see above).

Since the existing descriptions of the male of this species are mostly of a composite character and too superficial to enable recognition, a more complete account of its morphology seems necessary.

Male. — Integument. Throughout blackish brown, occasionally almost black, including the whole anterior surface of the head, except as follows: nearly invariably an orange spot at extreme base of mandibles; antennae dark brown, anterior faces of all segments yellow; segm. 1—3 usually sulphur yellow, the remainder orangish.

Structure. Labrum short, trapezoidal, about twice broader than long, strongly raised into a rounded tubercle; anterior border porrect, distinctly below level of main portion, feebly emarginate medially; whole surface coarsely rugose, except an inverted T-shaped or triangular median area, which is smooth and shiny. Mandibles with two rather deep lateral sulci from base almost to apex, basal portion with few scattered punctures; malar space smooth, microscopically tessellate. Front of head not protuberant, surface almost flat, frons and clypeus not swollen nor elevated, except the short and sharply defined frontal keel; whole anterior margin of clypeus evenly and shallowly emarginate, its surface evenly densely punctate; fronto-clypeal suture and an incomplete line down the middle of clypeus sometimes with fewer punctures, but clypeus without median impunctate ridge or line. Inter-antennal, antennal-ocular, ocello-ocular and interocellar spaces all about equidistant. Inner orbits weakly curved, eyes slightly converging anteriorly: distance between upper orbital extremities a little wider than that between the lower. Antenna with segment 3 equal in length to 4 + 5, or a trifle longer; 6 a little longer than 5. Surface of mesoscutum on level with that of scutellum. Posterior ridge of scutellum sharply acute, distinctly projecting beyond level of postscutellum and propodeum; propodeum markedly longitudinally sulcate, surface evenly superficially punctate, punctures smaller than interspaces.

Legs of simple structure. Coxae and trochanters flattened ventrally. Coxae I each with a flat, almost parallel-sided, lanceolate and bluntly rounded, mediobasal posterior process; both closely approximated basad but somewhat diverging apicad and for the most part concealed from view by long backwardly directed hairs. Postero-basal angle of trochanter I nipple-shaped or acute-angulate, that of II rounded, that of III more sharply pronounced than that of I. Femora of simple structure; femur III straight, gradually narrowed from base to apex, unarmed; longitudinal ventral keel straight, poorly indicated, acute only at apex, with tongue-shaped extero-apical lamella, keel fading away basad, the postero-basal angle rounded, not projecting beyond apex of trochanter; surface smooth,

rather shiny, the anterior portion evenly sparsely punctate, the posterior division more densely so (figs. 1—2). Tibia III gently curved, inner surface deeply and broadly hollowed out, intero-apical lamella tongue-shaped, longer than the exterior one at femur. Knee-caps about $^2/_5$ length of tibia, densely punctate, the apex obtusely pointed, smooth, very slightly outcurved.

Wing-membrane of the usual grey-brown tint, darker brown at costal margin and towards apex of fore wings, with strong cupreous and light purple iridescence all over. Fore wing with first two submarginal cells invariably closed (*r-m* vein complete); third intercubitus (*R4*) strongly convex, the bend situated mid-way its length. Abdomen relatively short, oval, moderately convex above; no median longitudinal carina and no distinct impunctate median line (occasionally a poorly indicated line posterior to 2nd gastral tergite). Dorsal surface of gaster slightly shining through the pubescence, especially after the first tergite; posterior margin of 2—5 linearly impunctate. Anterior rim of gastral tergite 1 subacute, except at extreme lateral edges, the border acute-angulate: anterior surface deeply hollowed out, with acarid pouch. Tergite 7 truncated, armed with a short, robust, narrowly triangular spine on either side of a widely U-shaped emargination. Sternites less densely but equally strongly punctate as compared with the tergites (densest apically) and much more densely punctate than the ventral surface of the thoracic segments, on which the punctures are superficial; sternites 1—5 with distinct, polished, median longitudinal stripe, widest basally and on 1—2; 6 with complete, strong, subacute, longitudinal carina. Genitalia, see figs. 3—5.

Pubescence (Plate 17 fig. 7). Generally short, dense and evenly distributed; concealing most of the surface on head, thorax and first gastral tergite, sparser on remaining segments; longest on scutellum and at lateral border and apex of the two terminal segments of abdomen. Pile suberect on front of head, at lower part of temples, and on top of occipital area, depressed around ocellar area and eyes. Hair thinner, erect, very dense and feathery, on dorsum and upper one-third of thoracic pleurae; thin and sparse on propodeum; decumbent on tegulae, extreme base of wings, and a short distance out along costal margin; short, rather dense, spine-like and decumbent on gastral segments 2—6, but longer, denser and more erect on the first. Pubescence on femora and tibiae normal, longest along the ventral carinae, very dense on upper parts of basitarsi. Gastral sternites sparsely covered with mostly decumbent short black hairs, posterior ones covering lateral portions of 2—5 longer, conspicuously greyish white or silvery. Colour in fresh specimens: on head, thorax, upper half of pleurae and first gastral tergite, wax yellow (front of head sparsely intermixed with longer, black hairs); on outer faces of all tibiae and rest of gaster, honey yellow to olive-ocher; on lower areas behind eyes, mesosternal area, propodeum, and anterior surface of first gastral, white. Coxae and trochanters with tufts of light hair; pubescence of femora rather sparse, mostly dark brown. Outer faces of tarsi I as well as most of the inner faces of tibiae and basitarsi II, black; incomplete velvet hair-streak at outer face of tibia III, deep black; basitarsus III also predominantly black, the hairs on its outer face silvery brown. Inner faces of tarsal segments 2—4 with dense cushion of orangish pubescence. Black hair-fringes at latero-ventral margin of gastral tergites 4—6 progressively longer from before backwards and terminating in dense tufts

on both sides at apex of 7.

Female. — Descriptions of this sex are found in the existing literature. The characters distinguishing it from *aestuans* are given in the table under that species.

Remarks. — From the above discussion and locality records it is evident that *pubescens* is an easily recognized and locally abundant species. Though apparently widespread in the northern parts of the Ethiopian region and western Asia, extending its range far eastward to Peninsular India, it is still impossible to give an adequate picture of the distribution of this bee. The habitats here quoted from the literature probably all refer to *pubescens*. Yet some of the known African and Asiatic localities are far and wide apart, suggesting a scattered occurrence, and the presumption that the species has been overlooked is not sufficient explanation for the existing gaps in its distribution pattern. This is the more striking because *pubescens* is a conspicuous bee, often found gregariously and easy to collect in quantity where it occurs. There is a citation to that effect published by ALFKEN (loc. vit., 1927) of a collector in Mesopotamia who observed the "Männchen spielend zwischen Dattelpalmen", and Dr. BRONGERSMA saw both sexes swarming around trees and among flowering shrubs at the banks of the Nile.

Mites as symbionts of *Koptortosoma*

Following Miss N. LEVEQUE's extensive studies of xylocopid bees with their symbiontic mites of the genus *Dinogamasus* Kramer, the present opportunity has been taken to remove a great number of these mites from the 'acari pouches' found on the female abdomen of various museum specimens of *Koptortosoma*. A number of these, taken from the bees that form the main subject of the present article, were submitted along with their hosts to Mr. G. L. VAN EYNDHOVEN, of the Zoölogisch Museum at Amsterdam, who has been kind enough to examine and study them.

A preliminary investigation of the mites found on members of the *K. aestuans* and *pubescens* groups of the bee-genus has proved of great interest, and I wish to thank Mr. VAN EYNDHOVEN for having complied with my request to report on his studies and summarize the results, with some illustrations, in a separate memoir to be published in the present volume shortly.

Xylocopa (Koptortosoma) bryorum (FABRICIUS, 1775)

Additional references:

1901. PÉREZ, Act. Soc. Linn. Bordeaux, 66 : 60. — ♂ Cochinchine (*Xylocopa separata* n.sp.) Syn. nov.

1902. CAMERON, Faun. Geogr. Mald.-Laccad. Archip., 1 (1) Hym.: 62, no. 23, "Common in the Maldives" (*Xylocopa aestuans* L.)

1938. MAA, Rec. Ind. Mus., 40 : 315—316. — ♂ type *X. separata* J. Pérez (not seen) considered synonymous with *X. verticalis* Lep. (= *ruficornis* F.)

1957a. LIEFTINCK, Proc. Kon. Ned. Akad. Wet., ser. C, 60, no. :441—447 (revision, incl. redescr. of type), figs. 10—21 (♂ structures, Malaya). — ♂ ♀ Thailand & Malaya [*X. (Maiella)*.]

1960. SAKAGAMI, Kontyû, 28 : 146. — ♂ Central Cambodia, Phnom Penh.

1961. SAKAGAMI & YOSHIKAWA, Nature and life in Southeast Asia, 1 : 411—412 (comp. notes, with *ruficornis* F.). — ♂ Bangkok.

Additional material. — Cochinchina: 1 ♂, labelled "Cochinch" and "*separata* J. P." in J. Pérez' writing, holotype *X. separata* J. P. (MP). Maldive Islands (Indian Ocean): 5 ♂ 3 ♀, Madewaru, Fadiffolu Atoll, 6—11.IV. 1958 (nos. x 2: 103—3—34), G. SCHEER; specimens of both sexes in the Hessisches Landesmuseum, Darmstadt, and the Leiden Museum.

A re-examination and dissection of the unique type of *X. separata* J. Pér., from Cochinchina, proves beyond doubt that it is synonymous with *bryorum* F. The specimen is indistinguishable from Siamese and Malay individuals with which I had confronted FABRICIUS' type, the former being still available for comparison with the type of *separata*. It has the submarginal cells completely closed and also agrees otherwise.

With regard to the development of the first intercubitus in the fore wing, I have observed that the tendency of this vein to become obliterated is, perhaps, more frequently to be noted here than was originally supposed (LIEFTINCK, loc. cit., 1957: 447). In the present series, this vein is complete in all but one male from the Maldives, where it fades away anally.

The discovery of *bryorum* on the Maldive Islands strongly confirms a former supposition, namely, that this species has a more westward distribution than *aestuans*. It means an interesting addition to the habitat of *bryorum*, extending its known range even beyond peninsular India. The males, after investigation of their genital organs, proved to be inseparable from the type and the Malayan specimens at hand, and I have quite satisfied myself that both sexes are conspecific.

Distribution. — From the Maldives and southern India, presumably through Burma, to Thailand, Indochina and the Malay Peninsula as far south as Singapore.

Xylocopa (Koptortosoma) ruficornis FABRICIUS, 1804

Additional references:

1841. LEPELETIER, Hist. nat. Ins. Hym., 2 : 195. — ♀ (not ♂ !) Inde (*Xylocopa verticalis* nob.). Syn. nov.

1957a. LIEFTINCK, Proc. Kon. Ned. Akad. Wet. Amsterdam, ser. C, 60, no. 3 : 434—440 (incl. references), figs. 1—9 (♂ struct.). — ♂ holotype & ♂ ♀ India & Ceylon, redescribed [*X. (Maiella) ruficornis* F.].

Additional material. — 1 ♀, with two drawer-labels: "*Xylocopa verticalis* ♀ Lep. T/ coll. Latreille D. de St. Fargeau/ Ind. or.", in Mus. Torino. — 1 ♀, sub *aestuans* F., in coll. BANKS, Brit. Mus. (Nat. Hist.).

Further to my revisional study of this species, the discovery of a second female in SPINOLA's collection removes all doubt about the status of LEPELETIER's *verticalis*, which is undoubtedly the same species as *ruficornis*. The example in question was examined by me in October, 1959 at Torino and agrees with FABRICIUS' insect in every respect. A second specimen perhaps of historical interest is a female "*aestuans*" Fabricius (nec L.) which I had the opportunity to examine in 1958 in the BANKS collection. This also is a true *ruficornis* which FABRICIUS evidently failed to associate with the male of that species described by him in 1804. As I have pointed out earlier (1957 : 441—443), MAA's *verticalis* is a mixture of *ruficornis* and *bryorum*. It is only natural that he considered *X. separata* J. Pér. as a synonym, because the latter is the same species as *bryorum* (see above).

Xylocopa (Koptortosoma) minor MAIDL, 1912

1912. MAIDL, Ann. Naturh. Hofmus., 26 : 304, figs. 46—48 (♂ posterior leg & genit.). — — ♂ "Sikkim" [*X. (Koptorthosoma) minor* n.sp.]

?1929. COCKERELL, Ann. Mag. Nat. Hist. (10) 4 : 141. — ♀ Siam, Chiengmai (*Mesotrichia confusa mckeani* subsp.n.)

?1929. COCKERELL, Ibid. (10) 4 : 303 (note). — Same specimens (*Mesotrichia confusa mckeani* Ckll.)

1961. SAKAGAMI & YOSHIKAWA, Nature & Life in Southeast Asia, 1 : 412 (ex parte?). — — ♀ Cambodia & Thailand [*X. (K.)* sp.].

Material. — Annam : 1 ♀, Phuc-Son, Nov.-Dez., H. FRUHSTORFER, ex coll. O. VOGT (MA). Burma : 1 ♂ 2 ♀, Lower Burma, Rangoon, 10.XI.1897, BINGHAM coll., P. HERBST coll. ex REED, *X. aestuans* L., det.? (CAS); series ♂, Middle Tenasserim, Haundraw Valley, 8.94, C. T. BINGHAM, ex coll. BINGHAM (BM). Thailand : 1 ♀, Siam, Bangkok, 24.XI.1929, pres. by G. LINSLEY (CAS).

The female of this species has not so far been described. Since BINGHAM's male and females from Rangoon were captured the same day, I assume that the two sexes are correctly associated.

Female. — The above specimens differ somewhat among themselves and I am not quite sure whether all of them belong to the same species. The downward extent of the yellow hair covering the dorsum of the thorax varies: in the Annam and Thailand females the light-coloured patch terminates alongside in a straight line at 1.7—2.0 mm below the insertion of the fore wings, whereas the examples from Rangoon only have a tiny yellow tuft directly under the wing-bases. Otherwise I can find no differences between them and all agree in possessing a low, narrow, impunctate median stripe down the clypeus.

The original description of *mckeani* Cockerell runs as follows: "Occiput with much yellow hair; yellow of thorax extending downward to form a rounded patch on each side just below the wings; first intercubitus incomplete below". In the paper published shortly afterwards, COCKERELL remarks that Miss N. LEVEQUE has found that "this form has no pouch for mites in the abdomen", to which he adds "Typical *confusa* Pérez, has a pouch. It seems probable that *M. mckeani* should be regarded as a distinct species." All our females correspond with COCKERELL's brief characterization and they appear to be devoid of an acari pouch. (In the specimen from Annam a number of minute Acari in the nymphal stage are adhered to the propodeum.)

Male. — Not at all resembling *aestuans* nob. and *bryorum* at first sight and also different from these species morphologically, resembling *pubescens* much more closely, especially as regards colour and nature of pubescence, the hairs being distinctly shorter and more evenly distributed than in *aestuans*. Our specimens agree in every respect with the original description of *minor* Maidl, a species in all probability erroneously indicated as from "Sikkim" (cf. MAA, 1938, Rec. Ind. Mus., 40 : 307). Unless some errors have crept into the draft of MAA's description of a "cotype" of *minor*, I believe that his specimen belongs to a different species. The author states that the mandibles are not emarginate (which is very unusual), and that the 3rd antennal segment is longer than segments 4—6 inclusive. In our

males the mandibles are strongly toothed and hollowed out intero-apically, and the 3rd antennal segment is only slightly longer than 4 + 5, which corresponds with Maidl's information.

The male of *minor* is easily distinguished from its allies by a combination of the following characters:

Base of mandible with yellow spot. A median longitudinal bar and a pair of transverse streaks (widest laterally) bordering anterior margin of clypeus, yellow; supraclypeal area also with triangular yellow mark. Antenna dark brown, scape and third segment anteriorly, yellow, the flagellar segments likewise paler (orangish) anteriorly. Coxa I ending in a slender, acutely pointed spine, which is only slightly flattened ventrad; trochanter I terminating posteriorly in a much shorter, though also acute, triangular tooth. Femur III neither greatly swollen nor expanded, lacking a distinct postero-basal lamella, the angle evenly rounded; mid-basal tooth replaced by a very low, roundish tubercle. Intero-apical lamella of tibia III strongly developed, forming a flattened, slightly curved, lanceolate process which is about three times longer than wide. Wings with complete first intercubitus, the bend of the weakly curved third intercubitus situated beyond the middle of its course.

Sakagami & Yoshikawa (loc.cit.) seem to have come across the same discrepancies as I have when identifying the *bryorum*-like females of *Koptortosoma* from continental southeast Asia. It is not precluded, therefore, that more than one species is involved; but, as far as I can judge, *minor* is certainly amongst these, and *mckeani* is very probably only a synonym.

Xylocopa (Koptortosoma) perversa Wiedemann, 1824

X. (Koptortosoma) perversa plagioxantha subsp.nov.

Material. — Malay Peninsula: 2 ♂, Perak, Larut Hills, 3700—4000 ft., 12.II.1932, H. M. Pendlebury; 1 ♀, Kedah, Catchment area near Jitra, 10.IV. 1928, H. M. Pendlebury, ex F.M.S. Mus. coll. Holotype ♂, Larut Hills; allotype ♀, Jitra; both in the British Museum (Nat. Hist.); one paratype ♂, in the Leiden Museum.

Both sexes are practically identical structurally with the typical subspecies, *p. perversa* Wied., from Java, and are of the same size. Total length of male 12.5—14.0 mm, fore wing 11.0—12.5 mm; female 15.0 and 13.0 mm, respectively.

Three distinct subspecies have so far been recognized, a fourth being here added. The male of *plagioxantha* is easily distinguished from all others by the broad, abbreviated yellow abdominal marks, but the female is closely similar to typical *perversa*. On the other hand, the males of *perversa* and *shelfordi* are not at all easily distinguished, whereas the females of both can be separated at a glance. Sexual dichromatism is most marked in the subspecies *coracina*. The differences between these four subspecies are perhaps best understood by employing the key-characters found in the pubescent colour-pattern, as given below. All males with distended abdominal segments seem to agree in exhibiting a dense fringe of white hair which projects from below the posterior margin of some of the preceding

tergites; it is paired at the base of the 5th and 6th, unpaired and median at the 7th.

X. (K.) p. perversa Wied.; ♂ and ♀ have been re-described in great detail by MAA (Treubia, 17 : 79—82, 1939).

X. (K.) p. shelfordi Cam.; ♂ and ♀ are described by CAMERON (J. Str. Br. Roy. As. Soc., 37 : 128—129, 1902) and MAA (loc.cit.: 82).

X. (K.) p. coracina v. d. Vecht; ♀ was described by VAN DER VECHT (Idea, 9 : 69, 1953); ♂, in great detail, and ♀ by LIEFTINCK (Verh. Naturf. Ges. Basel, 66 : 22—25, figs. 13—15, 1955), who also gave figures of the ♂ genitalia.

KEY TO THE SUBSPECIES

Males

1. Elongate yellow bands on dorsum of thorax and abdomen continuous, subparallel, equal in width or a little narrower than the black area enclosed, those on abdomen gradually diminishing in width posteriorly; colour light cadmium. Pale yellow bands bordering inner margin of compound eye comparatively narrow, but extending almost along full length, each a little broader than half the diameter of the black median area. Postoccipital area also with yellow hair-streak. Upper part of thoracic pleurae with large, ill-defined, patch of feathery yellow hair. Outer faces of tibiae and tarsi also conspicuously yellow 2
— Combined characters not as above, the yellow areas occupying more of the surface 3
2. Yellow bands on dorsum of abdomen longer, extending from base of 1st to beyond middle of 5th gastral tergite; 6th also with some scattered yellow hairs. Posterior border of gastral sternites 2—4 or 2—5 distinctly fringed with yellow laterally. Yellow bands on each side of frons longer. Basal half of mandibles superficially and scatteredly punctate. Hab.: Java . . *p. perversa*
— Yellow bands on dorsum of abdomen shorter, those at apex of 3rd gastral tergite and on most of the 4th intermingled with (or replaced by) black; 5 at most with few scattered yellow hairs at base; 6 black. Hair-fringes along posterior border of gastral sternites 2—4 black, scantily intermixed with yellow. Yellow hair-bands on each side of frons shorter and narrower. Basal half of mandibles with fewer, but larger and deeper, punctures. Hab.: Borneo . . . . . *p. shelfordi*
3. Pubescence of head deep black, frons and paraclypeal area with a mixture of yellow and black on either side along the eye-margin, these spots band-like and similar to those of *p. perversa* and *p. shelfordi*, but shorter, narrower, and less sharply defined. Postoccipital area with narrow yellow hair-streak. Thoracic pleurae black, save for a very small feathery patch of yellow beneath the implantation of the wings. Pubescence on dorsum of thorax longer than in *p. perversa* and *p. shelfordi*, the elongate light bands primuline yellow, each gradually but distinctly broadening posteriorly so as to become confluent across scutellum and enclosing a narrowly oval, black median area. Legs almost

wholly black, only outer faces of intermediate and posterior tibiae streaked with yellow. Wings as in *p. perversa.* Yellow bands of abdomen abbreviated, forming two broad, oval patches covering first two and basal portion of 3rd gastral tergites, the black area separating them on 1st tergite about half as broad as each of the yellow parts; remainder of abdomen black, but latero-ventral edge of 2nd tergite narrowly fringed with yellow. Hab.: Malay Peninsula . . . . . *p. plagioxantha*

— Pubescence in front of head throughout light yellow, that on top of vertex and occiput very dense, canary-yellow. Mesoscutum and most of the thoracic pleurae silvery yellow; on the scutellum it is light cadmium, on the post-scutellum and propodeum again silvery. Abdomen with a pair of complete, elongate, sub-parallel, light cadmium bands extending from base to apex and very gradually narrowing towards the end of same; black median area on first two tergites narrower than each of the lateral yellow patches, this dark median band also diminishing in width posteriorly, on the 6th tergite occupying only a small area equal in size to each of the lateral yellow spots; all sternites fringed with yellow towards apex. Hab.: Lesser Sunda islands, Lombok, Flores and Sumba . . . . . *p. coracina*

Females

1. Body almost entirely black-haired, pubescence densest on dorsum of thorax, but not entirely concealing surface; on first gastral tergite it is not so dense though rather long and erect, on succeeding tergites very sparse and decumbent, except marginally and on apical segments. Head in front predominantly whitish, temples and behind occipital ridge with fringes of white or grey; few white hairs also at latero-ventral margin of 2nd gastral tergite. Wings darker and less brilliant than in the other subspecies, with purplish, bronze, and blue (not golden) reflections. All gastral tergites with slight metallic blue lustre . . . . . *p. coracina*

— Body at least partly yellow. Wings with brilliant coppery and golden reflections. Gastral tergites black, lacking steely blue lustre; pubescence on first two segments concealing surface 2

2. Thorax above and upper parts of pleurae clothed with soft light turtle-green to citron-green pubescence, the hairs on basal two segments of gaster stronger, decumbent, slightly lighter yellow (primrose- to reed-yellow); rest of abdomen black and only sparsely pubescent. Head in front and temples black with few pale hairs intermixed . . . . . *p. shelfordi*

— Thorax entirely black-haired. Pubescence on basal two segments of gaster bright yellow lacking greenish hue. Head in front predominantly black-haired 3

3. Front of head with slight admixture of white or pale yellow hairs. Mesoscutum and gastral tergites 3—6 more shiny, less densely, and more superficially punctate. Colour-bands of abdomen darker yellow (light cadmium) . . . . . *p. plagioxantha*

— Front of head and temples with abundant admixture of whitish hairs. Mesoscutum and gastral tergites 3—6 more densely and deeply punctate. Colour-bands of abdomen empire-yellow to lemon-chrome . . . . . *p. perversa*

In October, 1959, when studying types in SPINOLA's collection, Torino Museum, I found two females *p. perversa* under a drawer-label "*Xylocopa zonata* M.B.", and with a yellow pin-label which reads "*Xyl. atricana* Lep.? ♀ Ddo. Hoffmansegg Java". As far as I am aware both names are nomina nuda.

In a previous memoir (loc.cit., 1955 : 24—25) I have published some field notes relating to the behaviour and habits of male and female *p. perversa* in Java, stating that nothing was known of the breeding-places and life history. I now have found a diary note kept by my colleague J. VAN DER VECHT, who made some observations on the species in western Java which are well worth translating: "The 27th September, 1936, while visiting Gunung Pantjar near Buitenzorg, I noticed a female *perversa* disappear in a hollow branch of a *Macaranga triloba* M.A. tree. The position of the dead branch was erect and the hole was about 75 cm from the ground; the diameter of the latter was 7.5 mm, that of the branch itself being 15 mm. After the branch had been slit open I noticed the bee to be still busy gnawing away in an upward direction the tissue of the interior, a tunnel about 70 mm in length being in course of preparation. The female was quite fresh, with undamaged wings, and there were some pollen grains adhering to its legs. Some males of *perversa* were seen visiting the small light purple flowers of *Stachytarpheta*, on the grass plain nearby". Two photographs accompanying the above note, taken in the laboratory garden at Buitenzorg, show two males *perversa*, one peeping out from the hole and another resting upon the branch outside.

Xylocopa (Koptortosoma) lundquisti LIEFTINCK, 1957 (pl. 17 figs. 9—10, textfigs. 6—10)

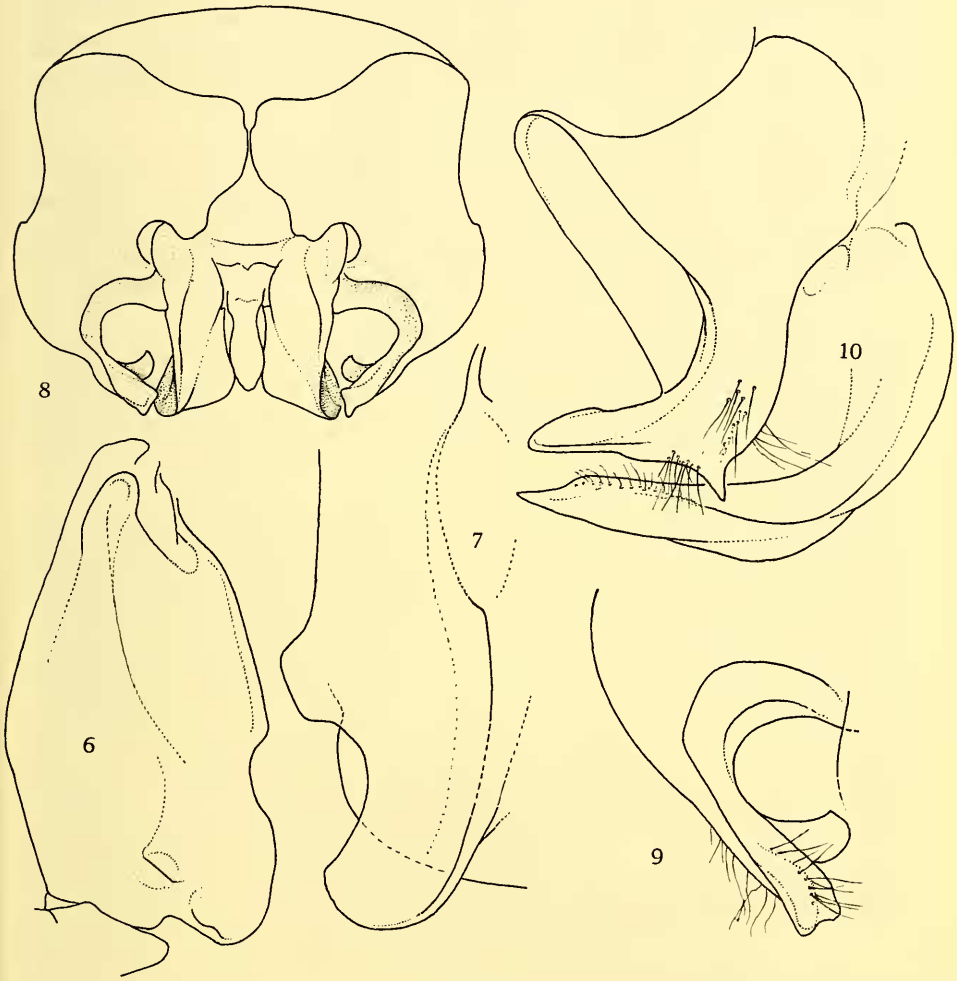
1957b. LIEFTINCK, Nova Guinea, new ser., 8 : 342 (key ♀), 352—353, fig. 55 (head ♀). — ♀ SW & S New Guinea [*X. (Maiella)*].

Additional material. — South New Guinea : 1 ♂ 1 ♀ (taken at nest), Merauke area, environs of Mindiptana, low country, VII.1958, Brother MONULPHUS, in the Leiden Museum.

Male (undescribed). — Integument. Throughout brownish black and deep black, with the exception of some yellow markings in front of head and antennae, as follows: a pair of small angular spots, one on each side, near anterior border of clypeus and a longitudinal stripe down its middle, the anterior margin itself as well as the rest of the surface remaining black. Basal three segments of antennae entirely black, the remainder dull orange-yellow anteriorly.

Structure. Head small, eyes prominent and of large size. Labrum very short, upper surface raised into a blunt, smooth and shiny, inverted T-shaped ridge. Mandibles with two distinct lateral sulci; basal portion with few large, the sulci with numerous very fine punctures. Malar space vestigial. Front of head not protuberant; clypeus flat, extremely densely punctate, except a distinct, slightly

raised, smooth stripe down its middle; supraclypeal and paraclypeal sutures more broadly impunctate, polished. Inter-antennal and antennal-ocular spaces about equidistant, as are also the ocello-ocular and inter-ocellar spaces, but lateral ocelli



Figs. 6—10. *X. (Koptortosoma) lundquisti* Lieftinck, ♂ from Mindiptana, South New Guinea. Fig. 6, right posterior femur; fig. 7, apex of left posterior femur seen from behind, more enlarged; figs. 8—10, genitalia and details thereof, dorsal (8—9) and left lateral view (10), different enlargements.

separated from the antennae by a much greater distance. Inner orbits weakly curved, distance between upper orbital extremities a little wider than that between the lower. Antenna with segm. 3 slender, longer than 4 + 5, 6 slightly longer than 5. Legs robust, modified. Coxae and trochanters relatively small; postero-

basal angle of trochanter I acute-angulate, that of II rounded, and that of III less acute than I. Femora expanded, base of I greatly swollen, its whole surface dull, microscopically tessellate, surface of II and III more shiny, sparsely superficially punctate, both strongly carinate posteriorly; femur III with greatly enlarged and strongly protuberant intero-basal lobe, the apex of which is curved ventrad, its surface dull, microscopically tessellate; basal process well developed, blunt (figs. 6—7). Tibiae rather broad and flattened, apical lamella of tibia III broadly oval, strongly hollowed out interiorly. Knee-caps poorly indicated by an oblique posterior (dorsal) ridge extending about $^1/_3$ length of tibia. Wing-membrane yellow-brown, considerably obscured along costal margin and towards apices of both pairs. Fore wing with first two submarginal cells incompletely closed, i.e., first abscissa of *Rs* (*r-m* vein) incomplete anally; third intercubitus (R_4 or im_2) only slightly outwardly convex, the bend situated beyond the middle. Abdomen relatively small, rather flat, tergites lacking a median impunctate line, the impunctate and hairless posterior margins of segments extremely narrow. Tergite 7 gradually narrowed and rounded apicad. Punctation of dorsal parts of integument dense, but completely hidden from view by the pubescence; latero-ventral surface of thoracic pleurae shiny and sparsely punctate, as also the smooth sternal plates of gaster, each of the latter with broad impunctate median area, widest basally; 6th sternite with strongly raised, though obtuse, smooth, median longitudinal crest, which is widest at apex. Genitalia, see figs. 8—10.

Pubescence. Very dense, erect and rather long on lower and posterior portions of head, whole dorsum of thorax including scutellum, and at posterior legs; shorter and thicker in front of head and around eyes; thin, rather dense and feathery on most of the thoracic pleurae; extremely dense, semi-erect (much shorter than on dorsum of thorax) on the disk of gastral tergites 1—5; hair on 6—7 and at latero-ventral edges of 2—7 again much longer and tufty, the apical tufts conspicuous and consisting of curly hairs. Pubescence of tibiae and tarsi also conspicuous, especially the long dense fringes at first two pairs. Coxal bases and gastral sternites 3—6 laterally with long tufts and broad fringes, which are pale yellow on coxae and sternites 3—5, black on disks and at sides of 6 (Plate 17 fig. 7).

Colour. Pubescence varicoloured: cream-buff, olive-ocher, ferruginous and black, as follows. Cream-buff are: head, thorax above and laterally, upper surface and posterior fringes of tibia and tarsus I, posterior fringe and extreme apex of tarsus II, and the tufts alongside gastral sternites. Olive-ocher are: gastral tergites 1—7, tuft at apex of femur III, and double hair-streaks at outer faces of tibiae II and III. Felt-like pile covering ventral surface of tarsal distalia I and II, ferruginous. Remainder of pubescence very dark brown or black, including a squarish patch between the antennae, whole basitarsus III, and lateral fringes at the apical gastral tergites.

Measurements: total length of body 22 mm, anterior wing 19 mm.

Female. — This specimen, taken with the above-described male, does not differ from the type, now also before me.

This is the first record of a Papuan *Koptortosoma* — apart from the common *X. (K.) aruana* Rits. — of which the female was actually found consorting with

its male, thus revealing without doubt their specific identity.

The following diary notes, referring to the above couple, were kindly supplied by Brother MONULPHUS : "Male and female first observed by Papuan boy, who saw bees entering nest and took both of them while resting inside hollow partition of soft-wood branch; diameter of branch 2 cm; contents of tunnel gnawed away for a distance of 11 cm; entrance hole circular, diameter 1 cm. Nest closed by boy, who kept bees securely inside branch and returned home taking a four hours' walk back to school."

Xylocopa (Subgenus?) ocularis J. PÉREZ, 1901

1841. LEPELETIER, Hist. Nat. Hym., 2 : 199. — ♀ Timor (*Xylocopa dimidiata* nov.)
1901. PÉREZ, Act. Soc. Linn. Bordeaux, 56 : 62—63. — ♀ Timor (*Xylocopa ocularis* n.sp.)
1953. VAN DER VECHT, Idea, 9 : 68, notes. — ♂ ♀ Timor (*Xylocopa dimidiata* Lep.)
1955. LIEFTINCK, Verh. Naturf. Ges. Basel, 66 : 25—27, fig. 16 (♂ genit., Timor). — ♂ ♀ Timor; ♀ Roti [*X. (Maiella?) dimidiata dimidiata* Lep.]
1959. HURD, Pan-Pacific Ent., 35 : 137—138, synonymy (*Xylocopa ocularis* Pér.).

HURD has reinstated *ocularis* J. Pér. as the correct name for this species, formerly known as *dimidiata* Lep. (nec *X. dimidiata* Latr., 1809).

In April, 1957, I could myself examine the type of *X. ocularis* J. Pér., labelled "Timor", in the Paris Museum, and confirm the correctness of the synonymy already established.

Of the alleged subspecies *kuehni* Friese, from the islands of Wetar and Kisar, I have examined three more females from Wetar and three others from Kisar, all of them corresponding with the type as regards colour of the head and thorax. A single male from the nearby island of Moa (off the NE point of Timor) differs from a good specimen of that sex taken on Timor. The body pubescence of this example is of a much darker tint, and it also has darker wings. Head, mesoscutum and scutellum are dark olive, but the hairs covering the hind margin, the postscutellum, the lower half of the sides as well as the ventral surface of the thorax are entirely black, as are also the whole of the gaster and posterior legs, except for a few ferruginous hairs noticeable at the outer faces of the basitarsus III. The anterior and intermediate legs in this specimen are also darker, only the hair-fringe at the tarsi II being bright ferruginous.

As regards colour, both sexes seem to vary a great deal and I am doubtful as to whether this variation is correlated with the isolated occurrence of these various forms on small islands.

Postscript, added April 3rd, 1964. — When this paper was in process of publication, I got acquainted with the excellent new book written by PAUL D. HURD, Jr. and J. S. MOURE, C.M.F., entitled "A classification of the large carpenter bees (Xylocopini) (Hymenoptera: Apoidea)", published by the University of California Press, Berkeley and Los Angeles, 1963, vi + 365 pp., 244 figs.

In this comprehensive work the Old World subgenera of *Xylocopa* are characterized and arranged in a key on pp. 164—290. For the Australo-Papuan species *X. ocularis* J. Pérez, 1901, the authors on p. 283 introduced the new subgeneric name *Cyphoxylocopa* Hurd and Moure, which should replace the word "Subgenus?" on p. 137 and 157 of the present article.

EXPLANATION OF PLATES

PLATE 16

Figs. 1—4. *Apis aestuans* Linné, holotype ♀ (Mus. LINNÉ, Uppsala), dorsal, lateral and frontal view. Upper row: same specimen taken from two different angles of illumination. — Figs. 5—6. *Apis leucothorax* De Geer, headless holotype ♀ (Mus. Stockholm), dorsal and partial lateral view, showing limits of coloured pubescence. — Measurements. Fig. 3: total length from apex of maxilla to tip of abdomen, 23.5 mm. Fig. 5 : wing-expanse on photo, 45 mm, body-length, 18 mm

PLATE 17

Figs. 7—8. *X. (Koptortosoma) pubescens* Spinola, ♂ from Syria and ♀ from Jerusalem. Enlarged on the same scale. Figs. 9—10. *X. (Koptortosoma) lundquisti* Lieftinck, ♂ and ♀ taken from nest, Mindiptana, S. New Guinea, VII.1958, Br. MONULPHUS. Enlarged on the same scale